10. Recalculations and Improvements

Each year, emission and sink estimates are recalculated and revised for all years in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks,* as attempts are made to improve both the analyses themselves, through the use of better methods or data, and the overall usefulness of the report. In this effort, the United States follows the IPCC *Good Practice Guidance* (IPCC 2000), which states, regarding recalculations of the time series, "It is good practice to recalculate historic emissions when methods are changed or refined, when new source categories are included in the national inventory, or when errors in the estimates are identified and corrected (IPCC 2000)."

The results of all methodology changes and historical data updates are presented in this section; detailed descriptions of each recalculation are contained within each source's description contained in this report, if applicable. Table 10-1 summarizes the quantitative effect of these changes on U.S. greenhouse gas emissions and Table 10-2 summarizes the quantitative effect on U.S. sinks, both relative to the previously published U.S. Inventory (i.e., the 1990 through 2002 report). These tables present the magnitude of these changes in units of Tg CO_2 Eq. In addition to the changes summarized by the tables below, four new sources—CO_2 emissions from non-energy use of fossil fuels and petrochemical production and N_2O emissions from settlements remaining settlements and forest land remaining forest land—have been added to the current Inventory.

The Recalculations Discussion section of each source presents the details of each recalculation. In general, when methodological changes have been implemented, the entire time series (i.e., 1990 through 2002) has been recalculated to reflect the change, per IPCC *Good Practice Guidance*. Changes in historical data are generally the result of changes in statistical data supplied by other agencies. References for the data are provided for additional information.

The following emission sources, which are listed in descending order of absolute average annual change in emissions from 1990 through 2002, underwent some of the most important methodological and historical data changes. A brief summary of the recalculation and/or improvement undertaken is provided for each emission source.

- *CO_2 from Fossil Fuel Combustion*. The most important change in the calculation was the revision that removed emissions from the non-energy use of fuels, which allowed them to be reported separately in the Carbon Emitted from Non-Energy Uses of Fossil Fuels source category. Overall, this change, along with several other alterations, resulted in an average annual decrease of 115.8 Tg CO_2 Eq. (2.2 percent) in CO_2 emissions from fossil fuel combustion for the period 1990 through 2002.

- *Land-Use Change and Forestry*. The most influential of the changes in the Land-Use Change and Forestry sector occurred in calculations for agricultural soil carbon stocks. These changes include: a new methodology for the evaluation and incorporation of uncertainty in manure amendments into the calculations for agricultural soil carbon, the use of new management factors provided in the IPCC *LULUCF Good Practice Guidance* (IPCC 2003), and revision of the land area included in the emission calculation for organic soils. Overall, these changes, in combination with adjustments in the other sources/sinks, resulted in an average annual decrease in net flux of CO_2 to the atmosphere from the land-use change and forestry sector of 89.0 Tg CO_2 Eq. (12.1 percent) for the period 1990 through 2002.

- *Landfills*. Revisions to the emissions calculation incorporated the use of a first order decay model rather than a linear regression model for 30-year waste in place figures, improved estimates of the annual quantity of waste placed in landfills, and more accurate estimates of emissions avoided by landfill gas to energy (LFGTE) projects and flaring. Overall, changes resulted in an average annual decrease in CH_4 emissions from landfills of 52.9 Tg CO_2 Eq. (26.0 percent) for the period 1990 through 2002.

- *Agricultural Soil Management*. The emissions calculation changed to incorporate the reallocation of emissions from fertilizer applied to forests and urban areas from the agricultural soil management source category within the Agriculture sector to the Land-Use Change and Forestry sector and the use of a Tier 3 methodology utilizing the DAYCENT ecosystem model rather than the Tier 1 methodology used in the past. Overall,

changes resulted in an average annual decrease in N_2O emissions from agricultural soil management of 31.2 Tg CO_2 Eq. (11.0 percent) for the period 1990 through 2002.

- *Petroleum Systems*. The calculation of emissions was revised to incorporate a modified emission factor for CH_4 emissions from oil tanks in the production sector and new activity factor for offshore Gulf of Mexico platform venting in the production sector. Overall, changes resulted in an average annual decrease in CH_4 emissions from petroleum systems of 7.1 Tg CO_2 Eq. (27.4 percent) for the period 1990 through 2002.

- *Natural Gas Systems*. The emissions calculation was revised to incorporate new Gas STAR emissions reduction data and the addition of three new emission sources in the production sector: CH_4 from gas condensate stored in tanks, unconventional gas well fugitives, and flaring from offshore Gulf of Mexico operations. Overall, changes resulted in an average annual increase in CH_4 emissions from natural gas systems of 6.7 Tg CO_2 Eq. (5.3 percent) for the period 1990 through 2002.

- *Mobile Combustion*. The most significant changes to this source were revisions to the emission factors for CH_4 and N_2O from highway vehicles, which were generated from EPA-sponsored laboratory vehicle testing. Revisions to these emission factors resulted in lower emission estimates for both CH_4 and N_2O emissions from highway vehicles. Overall, changes resulted in an average annual decrease in N_2O emissions from mobile combustion of 6.2 Tg CO_2 Eq. (10.9 percent) and an average annual decrease in CH_4 emissions from mobile combustion of 0.6 Tg CO_2 Eq. (13.6 percent) for the period 1990 through 2002.

- *Wastewater Treatment*. The most influential changes in the calculation were the use of an adjusted per capita BOD factor in the domestic wastewater emissions calculations and the use of more detailed field data for the meat and poultry industry in the industrial wastewater emissions calculations. Overall, changes resulted in an average annual increase in CH_4 emissions from wastewater treatment of 3.8 Tg CO_2 Eq. (14.0 percent) for the period 1990 through 2002.

- *Abandoned Coal Mines*. The calculation of emissions was revised to incorporate an updated mine list, updated coal seam permeabilities, and revised closure dates for 43 of the mines. Overall, changes resulted in an average annual increase in CH_4 emissions from abandoned coal mines of 2.8 Tg CO_2 Eq. (64.5 percent) for the period 1990 through 2002.

Table 10-1: Revisions to U.S. Greenhouse Gas Emissions (Tg CO_2 Eq.)

Gas/Source	1990	1997	1998	1999	2000	2001	2002
CO_2	**7.2**	**2.3**	**4.7**	**1.7**	**(0.8)**	**13.0**	**14.4**
Fossil Fuel Combustion	(102.9)	(120.8)	(133.7)	(142.9)	(128.5)	(110.8)	(109.5)
Non-Energy Use of Fuels[a]	108.0	120.3	135.4	141.6	124.7	120.1	118.8
Natural Gas Flaring	+	NC	NC	NC	+	0.7	0.9
Cement Manufacture	NC	NC	NC	NC	NC	NC	NC
Lime Manufacture	NC	NC	NC	NC	NC	NC	NC
Limestone and Dolomite Use	NC	NC	NC	NC	NC	NC	+
Soda Ash Manufacture and Consumption	NC	NC	NC	NC	NC	NC	NC
Carbon Dioxide Consumption	+	+	+	+	+	+	(0.3)
Waste Combustion	NC	NC	NC	NC	NC	NC	NC
Titanium Dioxide Production	NC	NC	NC	NC	NC	NC	NC
Aluminum Production	NC	NC	NC	NC	NC	NC	+
Iron and Steel Production	+	+	+	+	+	(0.2)	0.7
Ferroalloys	NC	NC	NC	NC	NC	NC	NC
Ammonia Manufacture & Urea Application	NC	NC	NC	NC	+	0.5	0.9
Petrochemical Production[a]	NC	NC	NC	NC	NC	NC	+
Phosphoric Acid Production	2.2	2.9	3.0	3.1	3.0	2.8	2.9
Land-Use Change and Forestry (Sink)	(84.2)	(109.1)	(175.2)	(150.4)	(132.3)	(137.1)	(135.8)
International Bunker Fuels	(0.4)	+	(0.5)	+	+	+	2.6
Biomass Combustion	NC	NC	NC	NC	NC	(3.9)	0.2
CH_4	**(37.3)**	**(49.3)**	**(51.0)**	**(55.8)**	**(60.3)**	**(58.3)**	**(55.6)**
Stationary Sources	(0.4)	(0.4)	(0.3)	(0.4)	(0.4)	(0.6)	(0.5)

Mobile Sources	(0.2)	(0.6)	(0.7)	(0.9)	(1.0)	(1.2)	(1.3)
Coal Mining	+	NC	+	+	NC	+	0.2
Abandoned Coal Mines	2.7	2.5	2.4	2.9	3.3	2.7	2.2
Natural Gas Systems	6.3	7.5	7.3	6.5	6.4	6.9	8.8
Petroleum Systems	(8.9)	(6.7)	(6.5)	(5.9)	(5.9)	(6.0)	(6.1)
Petrochemical Production	NC	NC	NC	NC	NC	NC	NC
Silicon Carbide Production	NC	NC	NC	NC	NC	NC	NC
Iron and Steel Production	+	+	+	+	+	+	+
Enteric Fermentation	+	+	+	0.2	(0.1)	0.2	0.2
Manure Management	0.2	0.1	0.1	0.1	0.1	0.1	(0.1)
Rice Cultivation	NC	NC	NC	NC	NC	NC	NC
Field Burning of Agricultural Residues	NC	NC	+	NC	NC	NC	+
Landfills	(37.7)	(56.0)	(58.1)	(63.8)	(68.6)	(67.0)	(66.2)
Wastewater Treatment	0.7	4.3	4.8	5.4	6.0	6.5	7.1
International Bunker Fuels	+	+	+	+	+	+	+
N_2O	**(11.2)**	**(40.0)**	**(24.4)**	**(46.2)**	**(23.9)**	**(31.4)**	**(35.3)**
Stationary Sources	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)	(0.5)
Mobile Sources	(6.9)	(5.1)	(4.2)	(4.0)	(4.2)	(6.1)	(7.3)
Adipic Acid	NC	NC	NC	NC	NC	NC	NC
Nitric Acid	NC	NC	NC	NC	NC	NC	0.5
Manure Management	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Agricultural Soil Management	(9.8)	(41.2)	(26.5)	(48.7)	(25.9)	(31.5)	(34.8)
Field Burning of Agricultural Residues	NC	NC	+	NC	NC	NC	+
Human Sewage	0.2	0.2	0.3	0.3	0.3	0.2	0.1
N_2O Product Usage	NC	NC	NC	NC	NC	NC	NC
Waste Combustion	NC	NC	NC	NC	NC	0.1	0.1
Settlements Remaining Settlements[a]	5.5	6.1	6.1	6.2	6.0	5.8	6.0
Forest Land Remaining Forest Land[a]	0.1	0.3	0.4	0.5	0.4	0.4	0.4
International Bunker Fuels	+	+	+	+	+	+	+
HFCs, PFCs, and SF_6	**0.3**	**0.1**	**+**	**+**	**(0.2)**	**(0.2)**	**+**
Substitution of Ozone Depleting Substances	0.1	0.1	+	+	(0.1)	(0.1)	(0.2)
Aluminum Production	0.2	+	+	+	0.1	+	+
HCFC-22 Production	NC	+	+	+	+	+	NC
Semiconductor Manufacture	NC	NC	NC	NC	NC	NC	NC
Electrical Transmission and Distribution	+	+	+	+	(0.2)	(0.2)	(0.1)
Magnesium Production and Processing	NC	NC	NC	NC	+	+	0.2
Net Change in Total Emissions[b]	**(41.0)**	**(86.9)**	**(70.7)**	**(100.3)**	**(85.2)**	**(77.0)**	**(76.5)**
Percent Change	**(0.7%)**	**(1.3%)**	**(1.0%)**	**(1.5%)**	**(1.2%)**	**(1.1%)**	**(1.1%)**

+ Absolute value does not exceed 0.05 Tg CO_2 Eq. or 0.05 percent.
NC (No Change)
[a] New source category relative to previous inventory.
[b] Excludes sinks from land-use change and forestry, and emissions from international bunker fuels and biomass combustion.
Note: Totals may not sum due to independent rounding.

Table 10-2: Revisions to Net Flux of CO_2 to the Atmosphere from Land-Use Change and Forestry (Tg CO_2 Eq.)

Component	1990	1997	1998	1999	2000	2001	2002
Forest Land Remaining Forest Land	(102.7)	(120.9)	(187.7)	(163.3)	(145.6)	(150.7)	(150.7)
Cropland Remaining Cropland	18.5	11.9	12.6	13.0	13.4	13.6	15.0
Settlements Remaining Settlements	NC	(0.1)	(0.1)	(0.1)	(0.1)	+	+
Net Change in Total Flux	**(84.2)**	**(109.1)**	**(175.2)**	**(150.4)**	**(132.3)**	**(137.1)**	**(135.8)**
Percent Change	**(8.8%)**	**(13.3%)**	**(24.8%)**	**(22.2%)**	**(19.2%)**	**(19.9%)**	**(19.7%)**

+ Absolute value does not exceed 0.05 Tg CO_2 Eq. or 0.05 percent.
NC (No Change)

Note: Numbers in parentheses indicate a decrease in estimated net flux of CO_2 to the atmosphere, or an increase in net sequestration.
Note: Totals may not sum due to independent rounding.